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Performance Specification

Fissile Material Monitor for the OU 7-10 Glovebox Excavator Method Project

Prepared for:
U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho

Idaho National Engineering
and Environmental Laboratory

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1. SCOPE

1.1 General

This specification is for a fissile material monitor (FMM) for the Operable Unit (OU) 7-10 (Pit 9) excavation. The purpose of the system is to ensure that the drums are not overloaded with fissile material. The fissile material administrative operating limit is 200 grams per drum. Fissile material monitoring will be performed by passive gamma ray spectroscopy with germanium detectors in each of the three gloveboxes. It is not intended to count all material going into the drums. Some types of material are not expected to have excessive fissile content. Material identified for assay, such as intact high-efficiency particulate air filters, filter media, and unidentified combustible material (defined as combustible [fibrous] material that cannot be readily identified as something other than filter media, such as clothing, rags, etc.) will be counted and the resulting measurement of fissile material will be tracked as a running inventory for each drum. Specific operating parameters are subject to change because of revisions in projections of OU 7-10 fissile material loadings. The FMM will be developed by Bechtel BWXT Idaho, LLC (BBWI) research and development (R&D) personnel.

1.2 Work Included

The primary deliverable will be a functioning fissile material monitoring system. Achieving this goal will require intermediate milestones and products, including drawings, procurement, assembly, installation, testing, and written manuals. Training, maintenance and the provision of calibration standards will also be included.

1.3 Work Not Included

The FMM will consist primarily of commercially available components. No effort will be made to design and build custom components. The specimen counting area will be designed by the OU 7-10 glovebox design team.

2. QUALIFICATIONS

This work will be performed by BBWI R&D personnel with expertise and past experience in detecting radioisotopes by their unique gamma spectrum peaks and in building systems to perform such analysis.

3. APPLICABLE CODES, PROCEDURES AND REFERENCES

The FMM will conform to the following codes and procedures:

- BBWI standard engineering practices and procedures
- MCP-2374, "Analysis and Calculations"
- DOE-ID, "Architectural Engineering Standards"
- NFPA 70, "National Electrical Code" (applicable sections)
- OU 7-10 Glovebox Excavator Method System Design Criteria
- MCP-3630, "Computer System Change Control."

Software written to perform the executive functions of this system shall comply with MCP-550, "Software Management," with regard to implementation of IEEE-1012 for verification and validation. Routines supplied by vendors to perform system support functions will be accepted as validated software.

4. SUBMITTALS

4.1 System Calculations

System calculations describing system components, operating parameters, and expected accuracy shall be documented in the engineering design file in accordance with project requirements.

4.2 Peer Review of Calculations

A peer of the designer shall provide an independent check of the design to ensure it is valid and provide documentation of this effort.

4.3 Vendor Data

Catalog and data sheets shall be supplied for off-the-shelf system components, and a copy of all documentation shall be provided for all custom built components. Electronic format is preferred for vendor data.

4.4 Spare Parts

A spare detector shall be provided and any other components whose failure would cause the loss of the FMM for more than 48 hours.

4.5 Test Plan

Research and development shall provide a written test plan addressing the items in Section 7.1 for project management approval.

4.6 Test Report

Research and development shall provide a written report of the test results from Section 4.5.

4.7 Operating and Maintenance Manuals

Research and development will provide manuals that give clear instructions for process operators to calibrate and operate the system. Manuals shall support routine maintenance and operation. R&D shall support the FMM for nonroutine operations and maintenance.

4.8 Drawings

Research and development will provide drawings for assemblies, for key commercial components where available, and for the system function and configuration as a whole. R&D shall provide all drawings necessary for installation and operation of the FMM. Drawing shall document as-built condition including modifications to commercial components. R&D shall use the dedicated instrumentation and control principal drafter.

4.9 Software

Software shall include documentation of verification/validation, software and system operating manuals, and code documentation.

5. SYSTEM REQUIREMENTS

5.1 General

A block diagram of the system, showing components and their connections, is attached (see Figure 1).

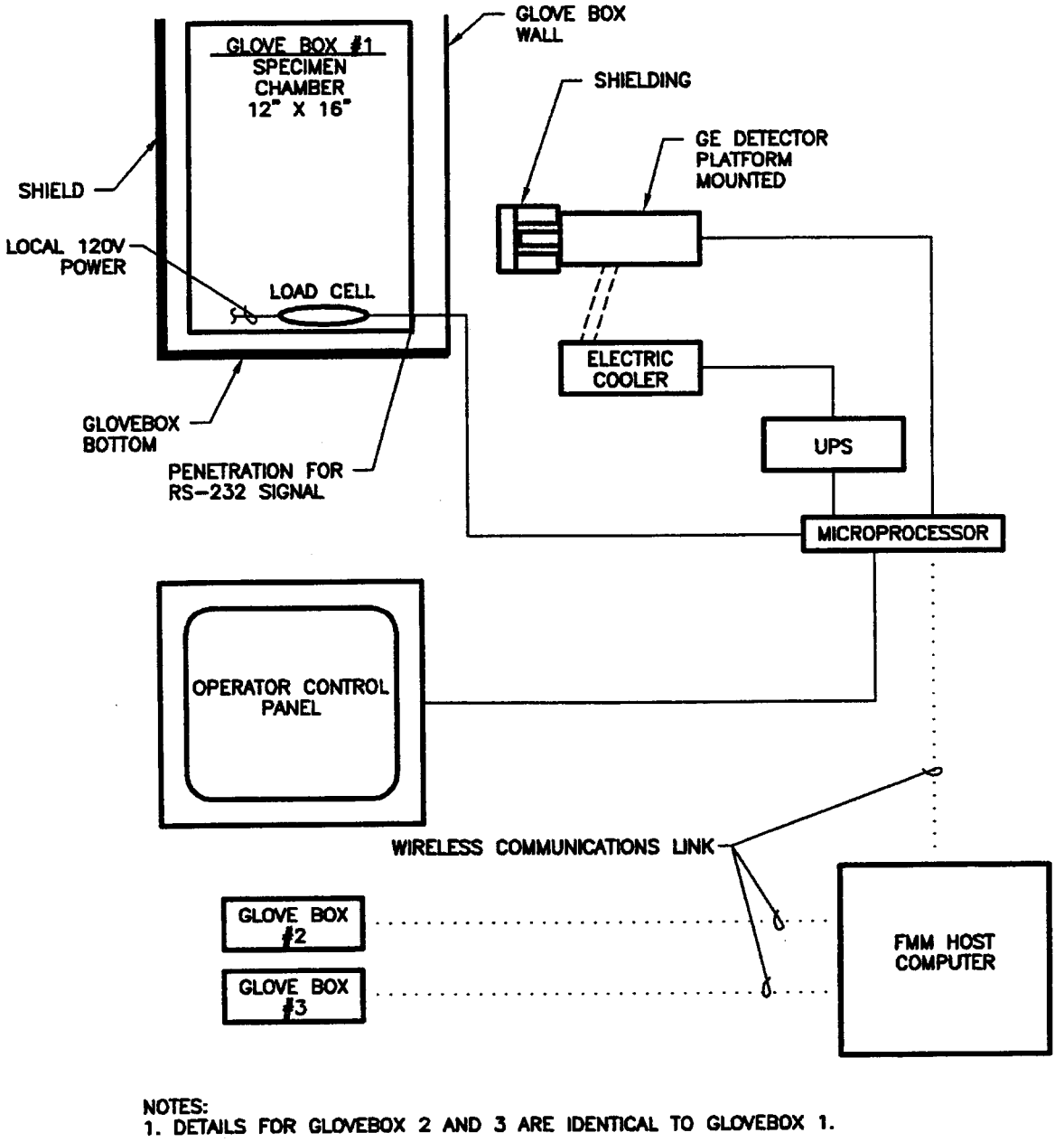


Figure 1. OU 7-10 fissile material monitor block diagram.

5.1.1 The fissile material monitoring system shall include detectors, coolers, human-machine interfaces, and computers to form a complete operating system.

5.1.2 The FMM system shall perform according to the logic flow diagram included in this document.

5.1.3 The detector shall be sized to read a cylindrical volume 12 in. in diameter and 14 in. high.

5.1.4 The specimen shall be separated from the detector by a window in the wall of the glovebox.

5.1.5 The system shall include electronic scales that provide a specimen weight directly to the computer operating the system. Electrical connections for equipment in glovebox shall include sealed bulkhead connector for penetrating the glovebox confinement.

5.1.6 The system shall be designed to compensate for the effects of background radiation in order to permit reliable fissile material monitoring.

5.1.7 The system shall be calibrated to accommodate the range of specimen densities expected from OU 7-10 material.

5.1.8 The system shall incorporate self-contained, electrically-operated coolers for the detectors.

5.1.9 A computer shall be provided at each glovebox station to perform the scan initiated by the operator on the touch screen and all the spectral analysis and subsequent calculations necessary and to provide the specimen fissile content to the operator in grams. This computer will maintain a running total of the scanned fissile material added to a drum currently being filled and provide the operator with an alarm indication if the current specimen would exceed a preset limit.

5.1.10 A central computer shall be provided to archive the data from all three glovebox FMM stations.

5.1.11 The detectors shall have mounts that provide electrical and vibration isolation. (The detector shall not be grounded to the glovebox.)

5.1.12 The FMM must fit within the space envelope provided by the OU 7-10 glovebox design team.

5.2 Performance Requirements

5.2.1 A touch screen operator interface shall be provided at each of the three gloveboxes. This touch screen shall provide for an operator to initiate a specimen count and shall display the specimen fissile content in grams, the cumulative drum total, and any appropriate system alarms. The system shall prompt the operator for a visual estimate of the volume of specimen material.

5.2.2 Detection Limits

The system shall be sensitive enough to detect as little as 1 gram of fissile material +/- 0.5 grams.

5.2.3 Isotopes to Detect

The system must detect either directly or by inference and be calibrated for Pu-238, 239, 240, and 241; Am-241; U-233, 235, and 238; CS-137; and Co-60.

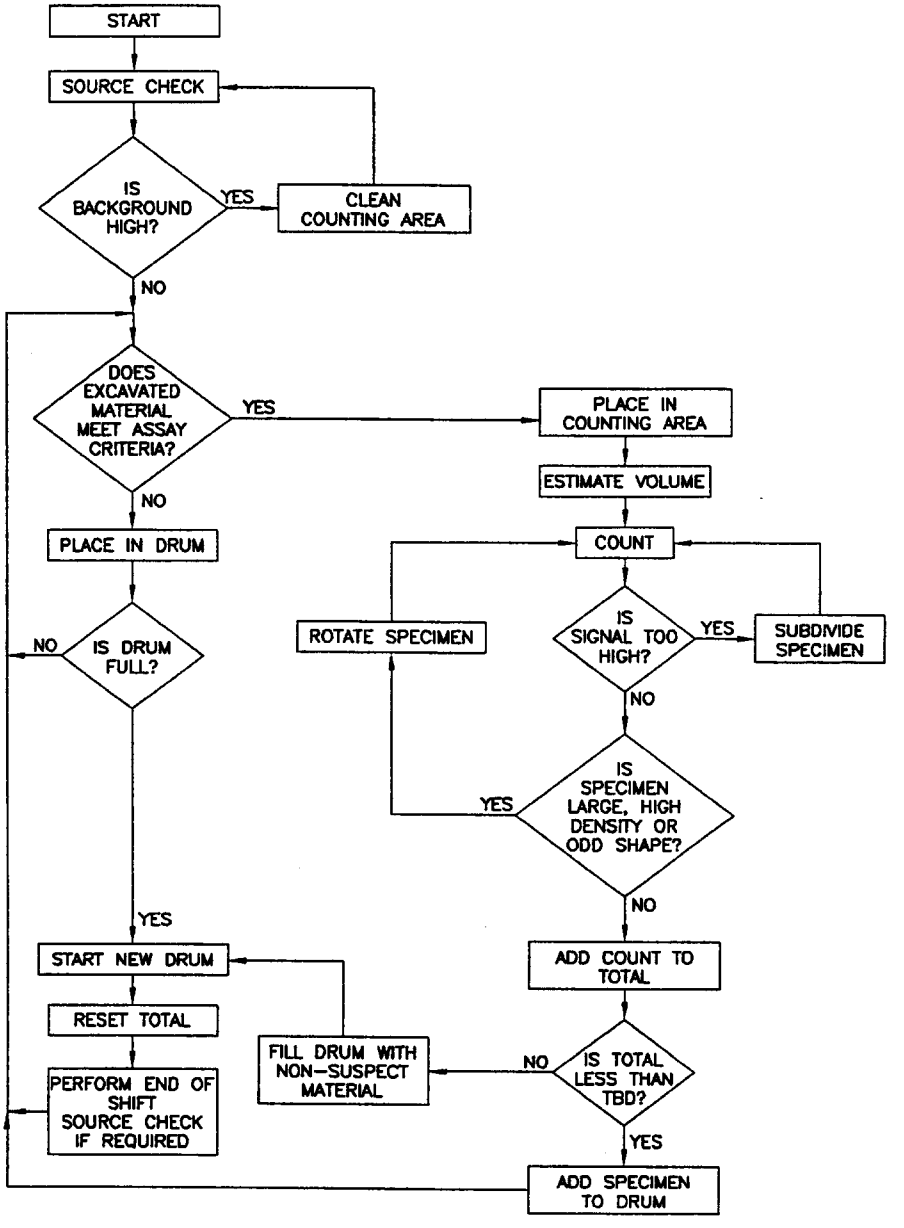
5.3 Software

5.3.1 Existing validated software shall be used to the extent possible for performing task subfunctions. New software written for this task shall perform high-level executive functions according to the included flow chart (see Figure 2). Particular values and precise definitions of terms are still to be determined.

5.3.2 The system as a whole shall be tested and validated.

5.4 Professional Engineer Certification

Professional engineer certification is not required for the staff designing and building this system, as it is more a matter of scientific development than engineering. They shall be qualified for the work according to Section 2 of this document.



NOTES:
1. THIS DIAGRAM IDENTIFIES SYSTEM FUNCTIONS. PARTICULAR VALUES AND PRECISE DEFINITIONS OF TERMS ARE STILL TO BE DETERMINED.

2. IF TOTAL IS GREATER THAN "TBD" IN THE BOTTOM DECISION BLOCK, THAT SPECIMEN IS SUBDIVIDED AS NECESSARY TO PRODUCE A COUNT LESS THAN "TBD" AND ADDED TO A NEW DRUM.

Figure 2. Fissile material monitor logic flow.

5.5 Human Factors

5.5.1 Touch screens shall be located for operator convenience and shall accommodate users wearing gloves.

5.5.2 The system shall conform to simplicity of operation principles referred to elsewhere in this document.

5.6 Reliability and Maintainability

5.6.1 The system shall be reliable enough to suffer no more than one failure during the processing campaign (approximately 100 days).

5.6.2 Spares of critical or long lead items shall be provided so that the mean time to repair is not more than 48 hours.

5.7 Environmental and Site Operating Requirements

5.7.1 Excessive radiation energy because of other isotopes in the specimen shall be dealt with by dividing the specimen into smaller sections as described in the logic flow sheet (see Figure 2).

5.7.2 The system shall be designed to operate at ambient temperatures between 50 and 100°F and for 15 to 85% humidity conditions.

5.8 Natural Phenomena or Abnormal Conditions

5.8.1 The system shall monitor the radiation level provided by background and other isotopes in the specimen. An alarm shall be provided if this level is too high to permit an accurate fissile material reading.

5.8.2 In the event of a power failure, the FMM shall retain the valid running total for the drum currently being filled, and records for previous drums, on the restoration of power.

5.8.3 The FMM shall maintain structural integrity in accordance with Performance Category-1 classification.

6. FABRICATION

Fabrication of the FMM shall be performed by the qualified people referred to in Section 2.

7. QUALITY ASSURANCE

The FMM procurement shall be for consumer grade items.

7.1 Operational Testing

7.1.1 Bench testing will be performed at the Incident Response Center.

7.1.2 System functional testing and actual source calibration will be performed at Test Reactor Area using actual fissile material with operations personnel.

7.1.3 A final system functional test will be performed after the equipment is installed at the OU 7-10 site.

8. EXECUTION

8.1 Installation

System installation will be a joint effort between R&D and BBWI technicians.

8.2 Startup and Calibration

Supplier shall calibrate the system in the final configuration.

8.3 Training

Supplier shall provide software and system operation manuals. Supplier shall provide equipment operations training.

8.4 Maintenance

Research and development shall provide on-call support for system maintenance as needed to support the operating schedule during the operating campaign.

9. PACKAGING AND SHIPPING

All packaging and shipping shall be performed by INEEL personnel.

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Specification

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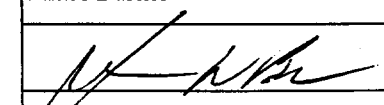		9-4-02		
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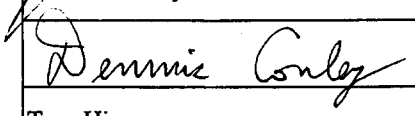		9/10/02		
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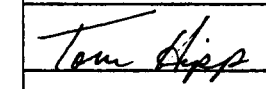		9/3/02		
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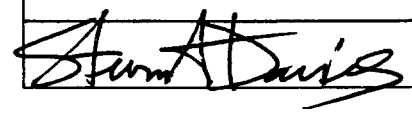		9/11/02		

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1. INTRODUCTION

1.1 System Identification

The objective of this project is to provide an integrated Fissile Material Monitoring System (FMMS) for the three Operable Unit (OU) 7-10 Glovebox Excavator Method Project gloveboxes used for processing waste. The objective of this document is to list and finalize the programmatic system and operational requirements to which the system will be designed. The purpose of the FMMS is to ensure that the drums do not exceed the operational control limit of 200 g of fissile material per drum. It is not intended to count all material going into the waste drums. Some types of material are by definition well characterized and are not expected to have excessive fissile content. Material, such as unidentified combustible material and filter media, will be counted in a specimen well, and the resulting measurement of fissile material will be assessed to determine if a drum filled with this material could exceed the 200-g limit.

This project will provide a highly automated assay system that will be used to quantify the fissile material content of specimens being transferred through the three gloveboxes that make up the waste handling system and the fourth system for other samples. The FMMS is composed of a shielded chamber in each glovebox; load cells in each glovebox; an electrically-cooled, collimated germanium detector; a data acquisition system; and an operator-controlled panel personal computer (PC). The panel PC functions as the processing system to alert operators through the touch screens concerning the following:

- the quantity and type of specified radionuclide(s) present
- if the waste meets the defined criticality guidelines for fissile content such that the material can be disposed of immediately
- immediate notification of the presence of high levels of radioactive or fissile material.

The system will also include a fissile material monitor (FMM) host computer that will serve as a backup storage medium for acquired spectra.

1.2 Limitations

The system is designed for use at the OU 7-10 Glovebox Excavator Method Project site and is integrated with the glovebox system and facility operational requirements.

1.3 Ownership

This specification is owned and is the responsibility of the OU 7-10 Glovebox Excavator Method Project, Pit 9 Operations, system engineer.

1.4 Definitions/Glossary

Alarm System – Alarm bell and light, which is used to indicate whether the gamma detector is being exposed to radiation fields outside its expected operating limit.

Cabling – Coaxial cable used to connect instrumentation and computers inside the controlled area with systems outside. Radiofrequency communications may be used where it offers an advantage over cabling.

Collimator – A physical shield that limits the field of view of the germanium detector.

Computer – For this application a standard laptop or desktop computer with Windows 98 or other compatible operating system will be used. This system will store spectral data and will provide spectral analysis including radionuclide identification and quantification.

Data Acquisition System – Computer software and hardware for obtaining, manipulating, analyzing gamma spectra, and producing quantitative measurements.

Detector Assembly – The detector assembly is composed of a single detector and shield that can be integrally located in the glovebox assembly.

Detector Enclosure – An enclosure used to prevent the measurement equipment from becoming contaminated and to provide shielding from nonspecimen emissions.

Gamma Spectrometer System – A gamma-ray spectrometer consisting of a Ge gamma-ray detector, power supply, preamplifier, amplifier, multichannel analyzer system, and software with computer interface for making measurements from the gamma isotopic detectors.

Gamma-Ray Detector – A high-purity germanium gamma-ray detector used to measure the gamma-ray emissions for identifying and quantifying the specific radionuclides present in acquired spectra.

Specimen Chamber – This is the chamber built onto the floor of the glovebox where waste will be placed to assay. The specimen chamber will have a built-in load cell to record the weight of waste and an inner liner that can be removed for decontamination. The specimen chamber will be shielded to prevent radioactive shine from the interior surface of the glovebox from reaching the detector (will be provided by engineering).

Minimum Detectable Activity – The minimum detectable activity (MDA) is a spectrum-specific statistical parameter used to identify the detection capability of the instrument. The MDA is the amount of activity that would have to be present in a given spectrum to be detected with a confidence of 95%. In a proper analysis system, measured and detected activity values are routinely reported at levels below the calculated MDA. These activity levels are detected at confidences less than 95%.

Operator Control Panel – Console used by operators to control the starting of the data acquisition system and to inform them of information, such as the concentration of fissile material and whether the debris exceeds defined fissile material limits.

FMM Host Computer – A computer station located in an uncontaminated area of the OU 7-10 Glovebox Excavator Method Project site used as a backup and supplementary storage location for spectral data acquired from the individual panel PCs. This host computer will also serve as an immediate spare should one of the panel PCs fail.

2. OVERVIEW

2.1 System Functions

The primary system functions are to:

- Determine if fissile material, activation, and fission products are present.
- Determine whether the fissile material content exceeds a defined MDA that is nominally 1 g of Pu-239.
- Determine the total quantity of fissile material present.
- Provide suitable uncertainty data for the measurements to provide assurance that the measured and summed quantity of fissile would not exceed 200 g in a drum. System development will determine the

confidence interval needed to provide assurance that the measured and summed quantity of fissile material plus the upper limit of its to be determined confidence interval could not exceed 200 g in a drum.

- Provide a load cell with a nominal range up to 100 lb that will be located in the specimen chamber inside the glovebox. This load cell will be interfaced to the operator-controlled panel PC.

- Provide an operator control interface such that the operator can perform the following functions:

  a. Energy calibrate and verify operability of the system at the beginning of each shift or as needed for verification with a radioactive source.

  b. Perform a background measurement once each day or whenever a change is suspected. If the background is not at acceptable levels, stop and find the source of the increased background.

  c. Enter the height to which the container in the chamber is filled. An accuracy percentage will determined in the FMMS Preliminary Hardware Design Engineering Design File (EDF).

  d. Start spectral acquisition.

  e. Determine if the specimen is large, odd shape, or has a high density. If any of these cases is true, the specimen will be rotated 180 degrees, and two counts will be taken.

  f. Verify that the material in the container in the chamber does not exceed operational limits for the system (e.g., density or mass distribution).

  g. Before releasing the sample being counted, determine if the fissile material content could exceed 200 g if the specimen content was added to the drum. If so, do not add to the disposal drum.

  h. Be informed of the fissile material content of the debris based on the summed measurements and appropriate scaling factors.

  i. Measure high levels of nonfissile material radioactivity and incorporate into the equation used to determine the MDA for this particular measurement.

- Direct measurements will be performed for the following radionuclides and reported as either a quantitative value with uncertainties or as a MDA (see Table1).

Table 1. Fissile material monitoring system radionuclides.

Material Type Measured	Radionuclide
Transuranic/fissile	Pu-238
Transuranic/fissile	Pu-240
Transuranic/fissile	Pu-241
Transuranic/fissile	Pu-239
Transuranic	Am-241
Fissile	U-235
Fertile	U-238
Fission	Cs-137
Neutron activation	Co-60
Fissile	Pa-233
Fissile	Pu-241

Other radionuclides may also be detected and will be reported. Those radionuclides that are determined by scaling factors to quantify the transuranic content or other radionuclide content will be tagged as determined indirectly from scaling factors.

2.2 System Classification

The safety category of this system has been identified as consumer grade. The procurement will be performed as quality level four. The integrated system will be qualified to quality level four through the system operability test, which will assess the systems capability to detect, quantify, and identify the presence of fissile material to the limits prescribed.

2.3 Operational Overview

This system is composed of gamma-ray detectors with electrical coolers, collimators, cabling, data-acquisition systems, computer, analysis software, and touch screen control panels at each of the gloveboxes. In addition, a load cell will

be located at each measurement chamber location for calculating density. Further, a power conditioner must be present at each measurement location. The FMM host computer will be located at a convenient location at the OU 7-10 Glovebox Excavator Method Project site.

3. REQUIREMENTS

3.1 System and Performance Requirements

3.1.1 System

3.1.1.1 The FMM shall consist of four main components: the detector assembly, data-acquisition system/microprocessor, and the operator's control assembly. Figure 1 shows the system block diagram.

3.1.1.2 The detector assembly shall contain a detector, associated electronics, and the detector collimator. This assembly will be positioned to view the "specimen chamber" where material will be placed for assay.

3.1.1.3 An enclosure, located in the glovebox, shall provide shielding to limit background shine to the detector. The radiation field surrounding the glovebox during normal glovebox operations should not exceed 5 mr/h.

3.1.1.4 The operator-controlled panel PC assembly is a control console to be located at each assay station for operators to perform assays on specified waste or material types. This assembly will meet the requirements as defined in Section 2.1 item 6.

3.1.1.5 The FMM host computer will serve as the backup storage medium for spectra acquired on the operator-controlled panel PCs and will be located in the Weather Enclosure Structure at OU 7-10 Glovebox Excavator Method Project site.

3.1.1.6 The system is designed to perform the measurement of radioactive materials with a range of radioactive concentrations and densities. Density and activity ranges will be defined in the FMM Preliminary Software Design EDF.

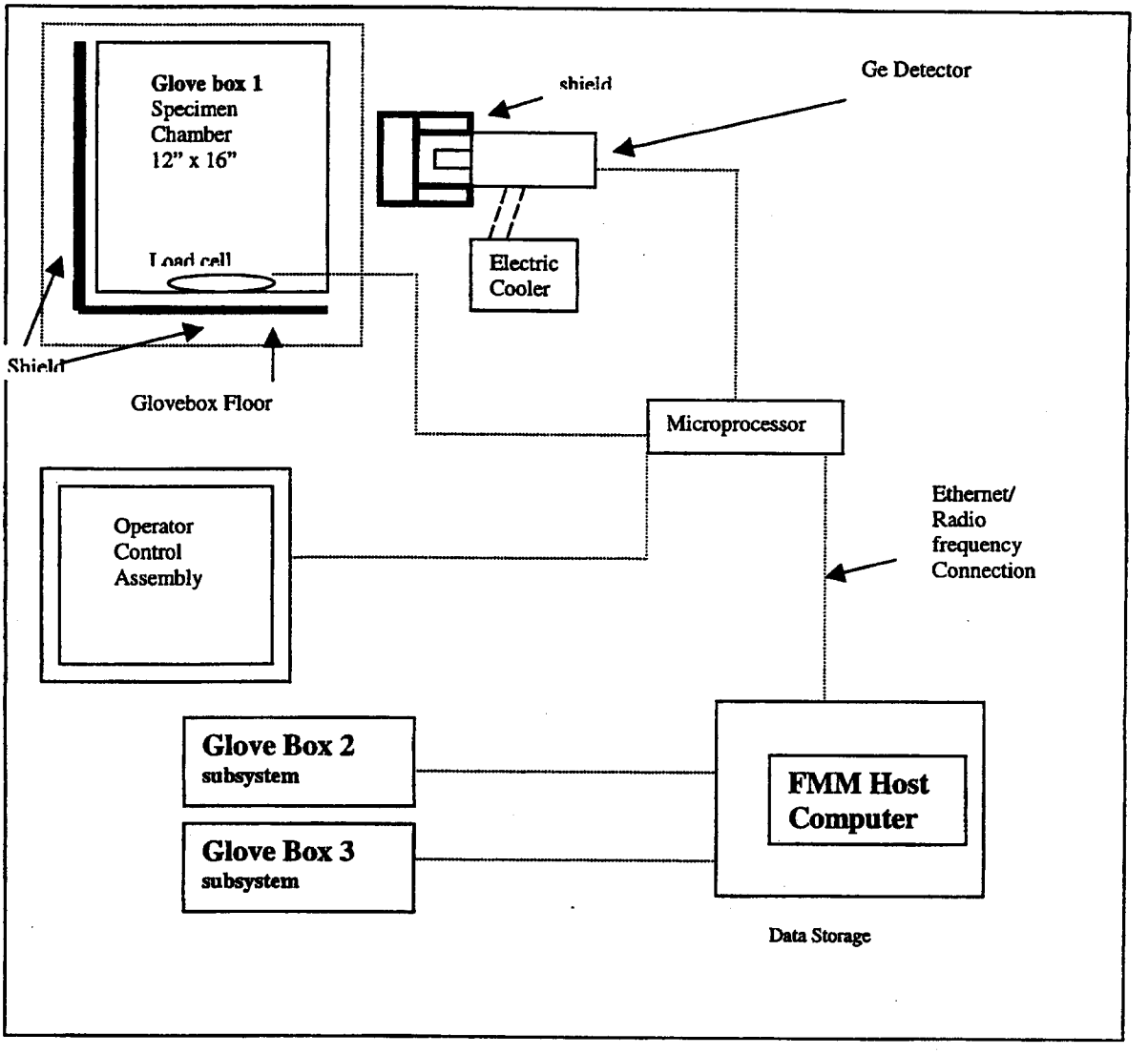

Figure 1. System block diagram for the OU 7-10 fissile material monitoring system.

3.1.1.7 The system must provide an estimate of radioactive material present and allow the quantity of fissile material present to be bounded with a to be determined confidence interval.

3.1.1.8 The ambient operating conditions are the humidity and temperature levels found at the OU 7-10 site. It is expected that the facility ambient operating conditions are nominally 50-100°F and 15–85% humidity. The design life is one year under the given conditions after installation at OU 7-10.

3.1.1.9 The sequence of events for operation is as follows (see Figure 2):

a. At the beginning of the shift, the system is performance checked by a qualified[a] operator locating a 10 μCiEu-152 source at a defined location in front of the detector or in the specimen chamber.

b. The operator will start the performance measurement process at the panel PC touch screen.

c. The panel PC touch screen will inform the operator that the system is calibrated.

d. The operator will perform a background measurement as indicated on the touch screen to ensure that there are not high levels of contamination in the chamber area. The computer will inform the operator of high background radiation levels.

e. The operator will place waste in the identified container and will then place the container in the chamber.

f. The operator will estimate the quantity of material in the container and touch the appropriate location on the panel PC touch screen.

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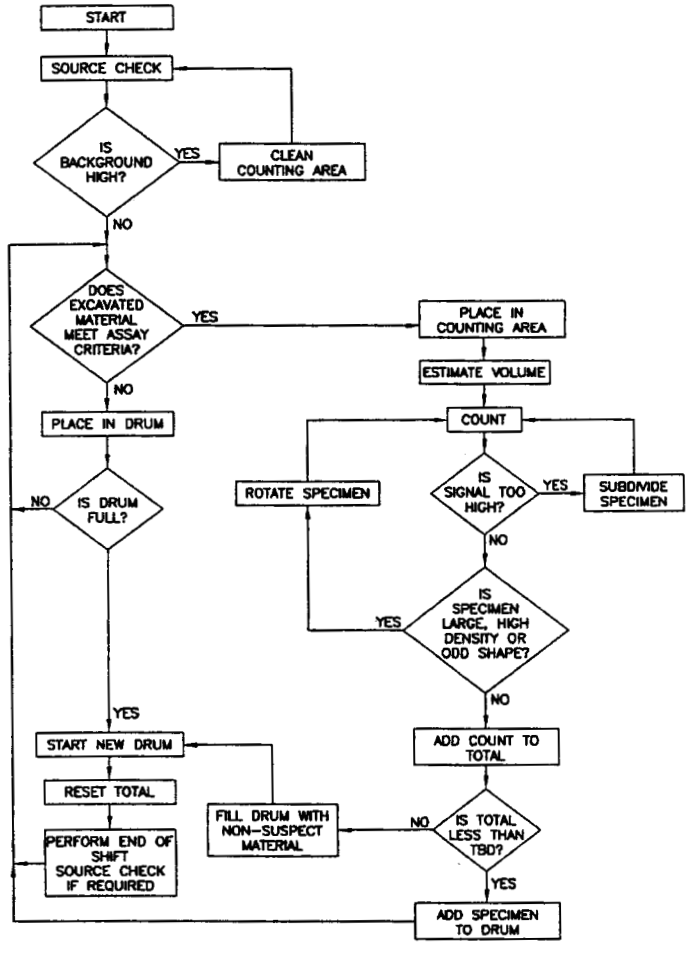
a. This training qualification will be documented in TRAIN.



NOTES:
1. THIS DIAGRAM IDENTIFIES SYSTEM FUNCTIONS. PARTICULAR VALUES AND PRECISE DEFINITIONS OF TERMS ARE STILL TO BE DETERMINED.

2. IF TOTAL IS GREATER THAN "TBD" IN THE BOTTOM DECISION BLOCK, THAT SPECIMEN IS SUBDIVIDED AS NECESSARY TO PRODUCE A COUNT LESS THAN "TBD" AND ADDED TO A NEW DRUM.

Figure 2. Fissile material monitor logic flow diagram.

g. The system will perform the gamma spectrometry measurement and will provide the information listed in Section 2.1 item 4.

h. The operator will then remove the waste sample (once it has been rotated 180 degrees and recounted, if necessary). If it is within acceptable levels, as

indicated by the touch screen, the operator will dispose of the sample as part of regular waste. If high levels are recorded, the operator will follow appropriate administrative procedures and will inform management that a high level of fissile material or high levels of radioactive material have been detected

i. At the end of the day's activities, the operator will repeat the calibration process if necessary to ensure that the system remained operable (i.e., calibrated) during the day.

3.1.2 Subsystem and Major Components

The components that will be procured include but are not limited to the following (see Figure 1):

- Germanium detectors with electrical cooling systems
- Alarm system for over ranging of the gamma detectors
- Gamma spectrometer data-acquisition systems and power supplies
- Complete gamma spectrometry analysis software package
- Load cells for the specimen chamber
- Appropriate cabling for the detector system
- Power conditioners at each location to minimize electrical interference
- Shielding and enclosure
- Items to be fabricated, including the collimators and cabling assemblies.

3.1.3 Boundaries and Interfaces

3.1.3.1 The primary boundary is the radiation boundary of the OU 7-10 Glovebox Excavator Method Project site dig area.

3.1.3.2 The operator-controlled panel PC touch screens and measurement assemblies will be located at each of the gloveboxes and at the other measurement locations to be defined by engineering and operations.

3.1.3.3 The FMM host computer station will be located in an area of the OU 7-10 Glovebox Excavator Method Project site dig area as defined by engineering.

3.1.3.4 Cabling for the load cells will pass through bulkhead connections from the gloveboxes to the individual data acquisition system computers.

3.1.3.5 Radio frequency communications will be used between the FMM host computer and the data-acquisition system computers.

3.1.4 Codes, Standards, and Regulations

The system will be designed according to the identified codes, standards, and regulations with the appropriate sections of the listed standards groups.

NEC	National Electric Code, NFPA 70
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories, Inc.
CFR	29 CFR 1910 OSHA Occupational Safety and Health Standards
N42.14-1999	Calibration and Use of Ge Detectors

Additional procedures and specifications include:

- MCP-2811, "Design Control"
- MCP-540, "Documenting the Safety Category of Structures, Systems, and Components"
- MCP-550, "Software Management"

- DOE-ID "Architect and Engineering Standard"
- TFR-155, "OU 7-10 Glovebox Excavator Method System Design Criteria, Instrumentation, and Controls"
- SPC-355, "FMM Performance Specification"

3.1.5 Operability

The gamma spectrometry measurement systems must be operable and calibrated prior to making measurements of waste in the gloveboxes or other materials. The system must notify operators of the system operability.

3.2 Special Requirements

3.2.1 System

The special requirements associated with this system are contamination control for the detector's electronic systems.

In addition, the systems must not be exposed to high levels of radio frequency noise, and appropriate power conditioning must be present to prevent changes in the system operability. (Note: Radios used by operations personnel must not create any potential interference.)

3.2.2 Detector System

The detector system itself must not and will not be contaminated by radioactive material.

3.2.3 Limiting Conditions

The FMM designer shall indicate with instructions any limiting conditions of operation such as welding or other potentially impacting operations.

3.2.4 Radiation and Other Hazards

Source accountability and storage must be addressed when sources are stored at the gloveboxes for use with the system. Accountability of these sources must be maintained by operations. The sources, 40 uCi of

Eu-152 are not highly radioactive (25 mrem/hr at 1 ft) and can be handled without significant radiation exposure.

3.2.5 As Low As Reasonably Achievable

The use of this system in the glovebox should minimize personnel exposure that might occur if individuals were contacting the material. There is no radioactive material associated with fabrication of the system. (See MCP-91.)

3.2.6 Nuclear Criticality Safety

Nuclear criticality safety relating to the FMM is discussed in the preliminary documented safety analysis and will be further developed in the final documented safety analysis (FDSA). Currently the FMM is not defined as safety-significant and is not expected to be as the FDSA is completed. However, the FDSA may have technical safety requirement (TSR)/limiting conditions for operations-level surveillance requirements relating to the operability, reliance, and calibration of the FMM to ensure the drum fissile loading limiting conditions for operations is met.

3.2.7 Industrial Hazards

The only potential hazard exposure to individuals is the cooling agent in the electrical cooling systems for the detectors if it were to leak or escape. This is highly unlikely; however, a material safety data sheet will be obtained for the cooling agent.

3.2.8 Operating Environment and Natural Phenomena

System to be used in the normal ambient operating environment found at OU 7-10 Glovebox Excavator Method Project site in the Weather Enclosure Structure. Items that must be addressed include:

- Equipment cabling must be run from the touch screens, the load cell, and the detector assemblies to the control computer without physically being damaged. (Radio frequency communication may be required.)

- The potential for high levels of background due to drum waste or contamination of the specimen chamber is addressed during the

calibration process or if there are indications that the chamber may have been contaminated.

- Radiation hardening is not required for this system based on the radiation fields expected at OU 7-10 Glovebox Excavator Method Project site
- The detector assembly must be sized to fit and operate under all expected conditions surrounding the gloveboxes.
- The FMM shall maintain structural integrity in accordance with Performance Category-1 classification.

3.2.9 Human Interface Requirements

Operations will perform all system operations through the control assembly according to the information requirements in Section 2.1.

3.2.9.1 The FMM will permit the glovebox operators to readily read and control the FMM from a control panel conveniently located at the glovebox.

3.2.10 Specific Commitments

There is a specific requirement from the OU 7-10 project to provide assurance that the fissile material content of drums does not exceed 200 g.

3.2.11 Continued Support and Evaluations

Physics staff will perform regular system evaluations and data evaluations of background and waste data to assess potential system and fissile material concentration issues.

3.3 Engineering Design Requirements

3.3.1 Civil and Structural

The individual assay system with shielding has a conceptual design weight of approximately 150 lb. Research and development will work with engineering to ensure that the FMM is structurally compatible with the gloveboxes once the final configuration of the assay system is known.

3.3.2 Mechanical and Materials

The detection system must be electrically isolated from the gloveboxes and must not be subjected to significant vibration and radio frequency noise from motors. It is anticipated that each detector will be placed on an electrically-isolated platform at the end of the glovebox with appropriate electrical isolation and shock mounting if significant vibration is expected.

An electrical cooling system will be used with the gamma detectors

3.3.3 Chemical and Process

None.

3.3.4 Electrical Power

Equipment shall be powered by standard 120 Vac, 20 A, ground fault interrupter protected receptacles with at least two outlets. Also power conditioners will be required for each system due to the potential for power variations at a field site such as OU 7-10.

3.3.5 Instrumentation and Control

The system will be operated using standard off-the-shelf hardware and software that has been demonstrated to meet the specific analysis requirements of accurate quantitative analysis with the exceptions of the load cell and control functions from the control assembly. In addition, data processing software will be tailored for this system as necessary.

The detection system must be electrically isolated from the gloveboxes.

The primary control channels are from the computer to the touch screens and the data acquisition and measurement systems under the gloveboxes. The control cables for the gamma spectrometer systems are for each system going to the various systems are the following:

- Data acquisition/detector systems—USB or ethernet
- Load cel—typical 9 or less conductor cable
- Touch screens—9 conductor cable.

Gamma Detectors

- Germanium detectors planar germanium—detector
- Transistor reset preamplifiers required for high rate operation
- Remote startup and control via Ethernet or USB connection
- Automatic high voltage shutdown.

Gamma spectrometer system

- Digital pulse processing
- Associated amplifier, high voltage supply, and preamplifier power
- Ethernet/USB control option
- Bias shutdown capability
- Process microprocessor
- Process spectral data with normal shaping times for semiconductor detectors with no significant degradation in resolution
- Gamma spectrometry analysis software—GENIE 2K or ORTEC Gamma Vision.

3.3.6 Computer Hardware and Software

Gamma spectrometry acquisition and analysis software includes standard laptop/desktop computer with Ethernet/USB access and Windows 98 and data acquisition software. All data will be backed up using the FMM host Computer.

3.3.6.1 Data acquisition software—analyze gamma spectra and produce quantitative measurements in accordance with calibration process to be defined in the Calibration Design EDF.

3.3.6.2 Complete gamma spectral analysis software that allows for calibration, efficiency, and complete spectral analysis.

3.3.6.3 A configuration management plan will be developed for the computer hardware software and documentation for the computer system in accordance with MCP-3630, "Computer System Change Control." This is the company implementation of the Institute of Electrical and Electronic Engineers standard on configuration management.

- Validation and verification of developed software as required according to MCP-550, "Software Management," Appendix F. Primary validation will be through system operations testing to demonstrate operability

3.3.7 Fire Protection

Nothing beyond existing facility protection.

3.4 Testing and Maintenance Requirements

3.4.1 Testability

3.4.1.1 Overall system calibrated with known National Institute for Standards and Technology traceable sources. Individual components tested in accordance with the consumer grade dedication requirements as listed in the purchase requisitions.

3.4.1.2 Physics will process the calibration results in a documented and approved EDF according to a standard technical procedure developed for the system operations testing and operations processes.

3.4.2 Technical Safety Requirement-Required Surveillance

There are currently no TSR-level surveillance requirements listed in the preliminary documented safety analysis. The FDSA may have a surveillance requirement associated with the limiting conditions for operations relating to the operational drum fissile loading limits.

3.4.3 Non-Technical Safety Requirement Inspections and Testing

Calibration report will be documented in an EDF. A technical procedure requirement for operations will be used to ensure that the detectors have

current calibration and will be calibrated on a frequency in accordance with the calibration EDF.

3.4.4 Maintenance

Periodic system calibration using technical procedure requirements assures system operability. Current planning is to provide spares for all critical components. There are no specific maintenance items required.

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material Protection

Access to the software and hardware must be limited as special nuclear material decisions are being made based on the results of the analyses. Password protection will be used.

3.5.2 Special Installation Requirements

The equipment must be able to be installed at the OU 7-10 Glovebox Excavator Method Project gloveboxes. Because of the uniqueness and special features of the FMM, the system will be installed by Idaho National Engineering and Environmental Laboratory crafts and technicians with instructions and guidance from research and development.

3.5.3 Reliability, Availability, and Preferred Failure Modes

This equipment must ensure that operability of the system is identified to operators and that failures due to high activity levels and potential electrical problems result in a defined failure mode. Likely failure modes are:

- Detector failure—results in unacceptable calibration
- Power instability—poor data and bad calibration
- High activity levels—detected during measurement process (operators informed)
- Must meet the reliability as required in the FMM Performance Specification.

3.5.4 Quality Assurance

Consumer grade and quality level four requirements to all equipment for initial design. The entire system exclusive of the structural components will be qualified through the system operations test

3.5.5 Miscellaneous

None.

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